Risk Assessment

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Atoms for Peace After 50 Years

Workshop III: Cross-Cutting Issues

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PRA Impact

Pre-PRA (before 1975)

- Management of (unquantified at the time) uncertainty was always a concern.
- Defense-in-depth and large safety margins became embedded in the regulations.
- Design basis and beyond design basis accidents.

Post-PRA

- The system is viewed as a socio-technical system.
- Risks and uncertainties can be quantified.
- The dominant contributors to risk can be identified.

Reactor Safety Study (WASH-1400, 1975)

Prior Perceptions of Nuclear Safety Experts

- The core damage frequency (CDF) is very low
- The accident consequences would be disastrous

Technical Assessments by Nuclear Safety Experts

- CDF higher than previously believed (median: 5×10^{-5} per reactor year; upper bound: 3×10^{-4})
- Accident consequences significantly smaller

Lesson Learned

- Perceptions, even those of experts, can be wrong.

Evolution of PRA Use

Phase 1

- **The value of the methodology is questioned by safety experts who are uncomfortable with the explicit quantification of judgment.**

Phase 2

- **Vulnerabilities identified by PRA are dealt with.**

Phase 3

- **Unnecessary safety requirements ("regulatory burden") are removed.**

Current State of Regulations

- **The regulations in the US are largely traditional but are slowly being risk-*informed*.**
- **Efforts to remove unnecessary regulatory burden coincided with the introduction of the term "risk-informed" regulations.**
- **Communication failure: "Risk-informed" is identified with "burden reduction."**
- **No significant public opposition to risk informing the regulations in the US.**
- **Foreign regulators are watching the US developments.**

Involving the Public: The Analytic-Deliberative Process

- ***Analysis*** **uses rigorous, replicable methods, evaluated under the agreed protocols of an expert community - such as those of disciplines in the natural, social, or decision sciences, as well as mathematics, logic, and law - to arrive at answers to factual questions.**

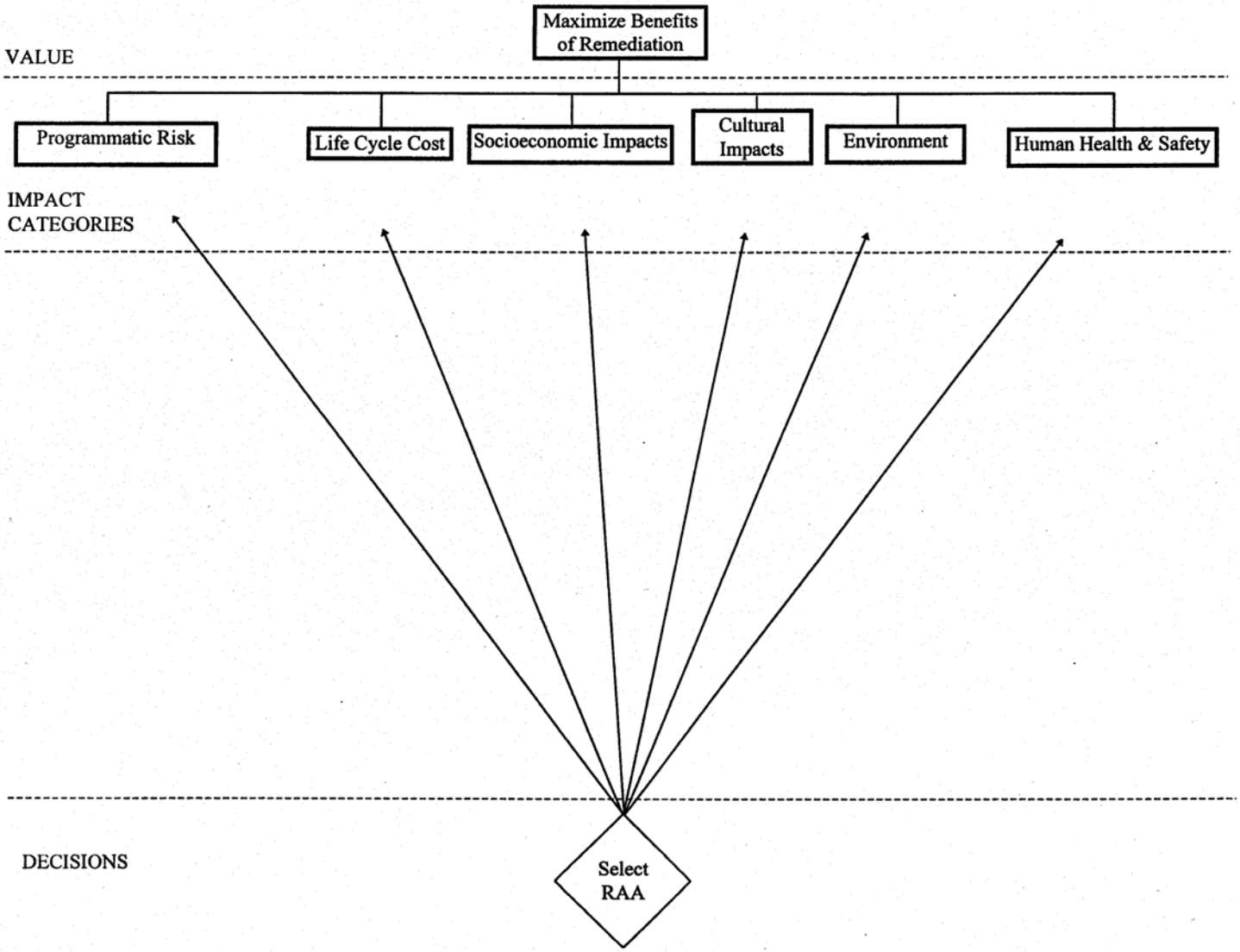
- ***Deliberation*** **is any formal or informal process for communication and collective consideration of issues.**

National Research Council, *Understanding Risk*, 1996.

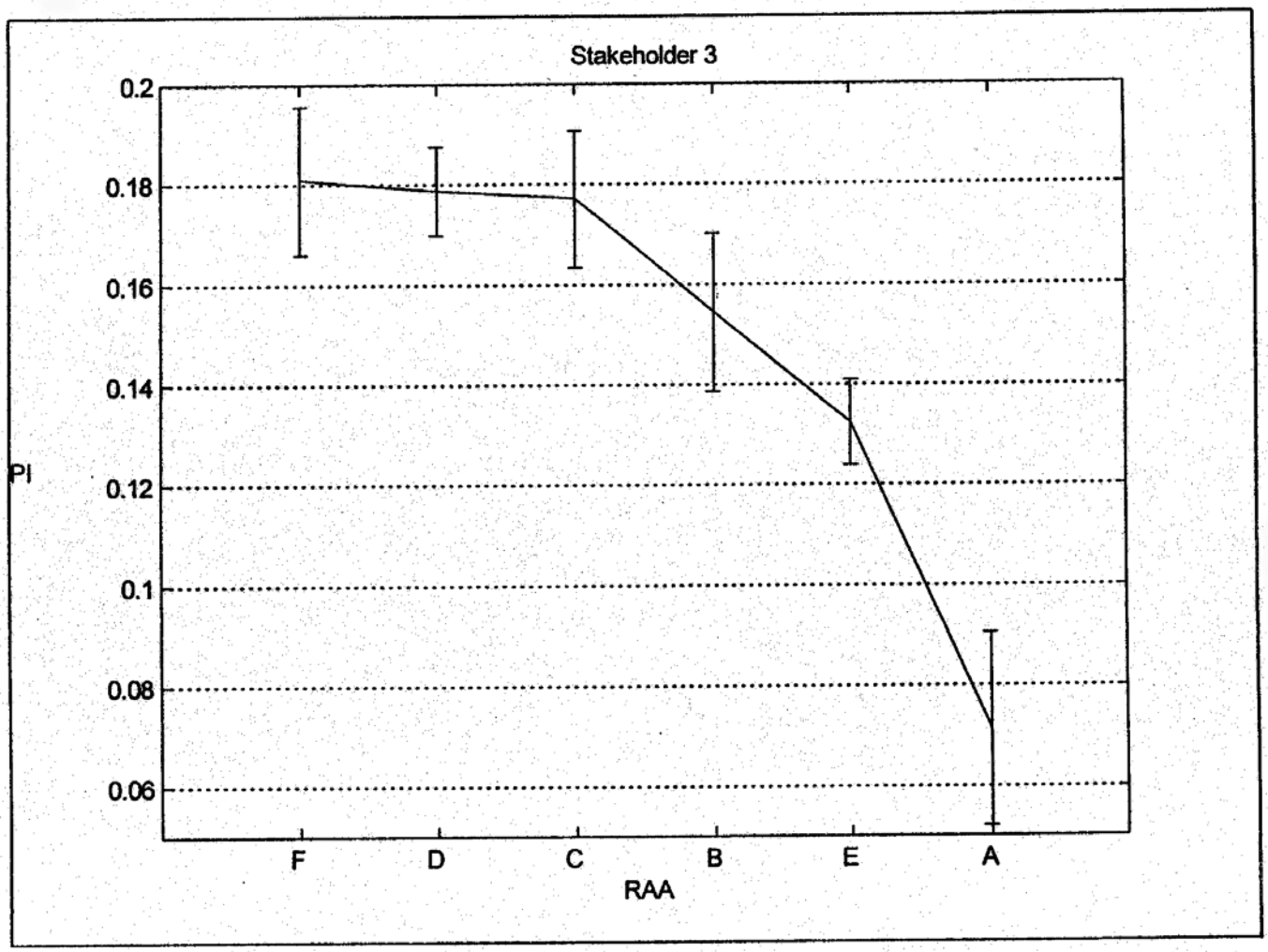
Case Study: Stakeholders

Stakeholder	Organization
1	Real Estate Agent
2	National Laboratory Employee
3	City Environment and Health Department
4	Middle Rio Grande Council of Governments
5	National Laboratory Employee
6	Community Advisory Board

Building the Value Tree



Results for One Stakeholder



Major Contributors

Stakeholder 1	Stakeholder 2	Stakeholder 3
RAA F is preferred *Does not employ workers, no worker health risk* *Does not generate waste* *Leaves contaminant in the ground* **RAA C and RAA E are less preferred than RAAF** *B and C have substantial reduction in groundwater contaminant risks* *RAA F performs better in Worker health risk* *C has higher completion costs* *E transports more wastes off-site* **RAA B is slightly less preferred than C & E** *Yields a higher amount of contaminant in the groundwater* **RAA D is less preferred than B** *Transports more waste off site* *RAA D has a higher completion cost* **RAA A is inferior to other RAAs** *High completion cost* *High worker health risk* Uncertainty analyses on performance output indicates that the rankings of RAA B, C, and F are not significantly different. RAA F and B indicate a lower uncertainty & perhaps less likely to fluctuate in the deliberation. E and A appear stable (quantitatively).	**RAA F is preferred** *No short term public accident risks* *Strong concern for public health* **RAA E performs worse than RAA F** *E has more transported wastes* *lower performance on implementation costs,* *due to the number of workers and trucks involved* *E is better than F in removal of contaminant yet poor performance in short term health due to transportation of waste* **RAA B is similar to E in preference** *B is on-site and thus lower costs and less transported waste* *B has higher long term public risk of cancer* **RAA C and D are less preferred** *higher completion cost due to technology (thermal desorption) and the cost of the disposal of the treatment of the residuals.* **D transports wastes off-site which leads to higher costs** *RAA A is least preferred* *Poor performance under worker and public health risks* *High completion cost.*	**RAA F is slightly preferred over the other RAAs** *No worker injuries unlike the other RAAs yet leaves the contaminant in the ground* *Transportation of waste is the performance measure which adversely affects the other RAAs in comparison to F* **RAA C and RAA D perform closely with RAA F** *The tradeoff here is that they remove the contaminant which counteracts their poor performance in regards to worker health* **RAA B is average** *B performs worse than C and D in contaminant removal since the contaminant remains on site* *B has a lower Completion Cost than C and D* **RAA E is less preferred** *High Implementation Cost* *Significant ER and Transported Waste compared to C and D* *Higher volume of transported waste, therefore E is more costly* **RAA A gives substantially lower performance** *In-situ Vitrification which yields high worker health risks* Uncertainty analyses on the performance output of the RAAs show that these preferences are rather stable and that F, D and C are not markedly different.

Major Contributors to Individual Stakeholder Preferences

Lessons Learned

1. Some stakeholder values appear at the time of decision only (desire to "punish" DOE in this case).
2. Stakeholder willingness to participate was very important.
3. Non-technical stakeholders are reluctant to participate in the "analysis." They are influenced by technical stakeholders who have gained their trust.

Lessons Learned (cont.)

4. The identification of major reasons for individual stakeholder preferences was very useful.
5. Technical uncertainties were meaningful to technical people only.
6. Continuing issue: How much information should be given to the stakeholders without appearing to attempt to bias them?